

1. A functionalized nanocrystal comprising a plurality of polynucleotide strands of predetermined sequence wherein a terminal portion of each of the plurality of polynucleotide strands is operably linked to the functionalized nanocrystal, and wherein the opposite terminus of each of the plurality polynucleotide strand is unbound to the functionalized nanocrystal and extends outwardly from the functionalized nanocrystal.

2. The functionalized nanocrystal according to claim 1, wherein reactive functionalities are used to operably link the plurality of polynucleotide strands to the functionalized nanocrystal.

3. The functionalized nanocrystal according to claim 2, wherein the functionalized nanocrystal comprises reactive functionalities, and wherein a reactive functionality of the reactive functionalities is selected from the group consisting of an amino group, a carboxyl group, thiol-reactive group, and a combination thereof.

4. The functionalized nanocrystal according to claim 2, wherein each polynucleotide strand of the plurality of polynucleotide strand comprises a reactive functionality selected from the group consisting of an amino-reactive group, a carboxyl-reactive group, and a thiol group.

5. The functionalized nanocrystal according to claim 1, wherein a linker is used to operably link a polynucleotide strand of the plurality of polynucleotide strands to the functionalized nanocrystal.

6. The functionalized nanocrystal according to claim 5, wherein the functionalized nanocrystal further comprises linker comprising avidin, wherein each polynucleotide strand of the plurality of polynucleotide strands further comprises biotin, and wherein the biotin is bound to the avidin.

7. The functionalized nanocrystal according to claim 1, wherein the functionalized nanocrystal comprises a semiconductor nanocrystal.

8. The functionalized nanocrystal according to claim 1, wherein the functionalized nanocrystal comprises a doped metal oxide nanocrystal.

9. The functionalized nanocrystal according to claim 1, further comprising molecular probe operably linked to the functionalized nanocrystal.

10. The functionalized nanocrystal according to claim 9, wherein molecular probe and the functionalized nanocrystal are operably linked using means selected from the group consisting of by a reactive functionality on one or more of the plurality of polynucleotide strands and a reactive functionality associated with the molecular probe, by a reactive functionality on the coating of the functionalized nanocrystal and a reactive functionality associated with the molecular probe, by a linker which has one portion that binds to a reactive functionality on one or more polynucleotide strands and another portion which binds to a reactive functionality associated with the molecular probe, by a linker which has one portion that hybridizes to one or more polynucleotide strands

and another portion which hybridizes to the molecular probe comprising a nucleic acid molecule, and by synthesizing the molecular probe as part of one or more polynucleotide strands.

11. The functionalized nanocrystal according to claim 9, wherein molecular probe and the functionalized nanocrystal are operably linked, wherein the functionalized nanocrystal further comprises avidin, wherein molecular probe further comprises biotin, and wherein the biotin is bound to the avidin.

12. A plurality of functionalized nanocrystals comprised of a functionalized nanocrystal according to claim 1, wherein a first species, primary dots, of the plurality of functionalized nanocrystals comprises a plurality of polynucleotide strands of a predetermined sequence; and a second species, secondary dots, of the plurality of functionalized nanocrystals comprises a plurality of polynucleotide strands of a sequence complementary to the sequence of the plurality of polynucleotide strands of the primary dot.

13. A plurality of functionalized nanocrystals comprised of a functionalized nanocrystal according to claim 9, wherein a first species, primary dots, of the plurality of functionalized nanocrystals comprises a plurality of polynucleotide strands of predetermined sequence; and a second species, secondary dots, of the plurality of functionalized nanocrystals comprises a plurality of polynucleotide strands of a sequence complementary to the sequence of the plurality of polynucleotide strands of the primary dot.

14. The functionalized nanocrystal according to claim 3, wherein the primary dots and secondary dots are of a uniform size.

15. The functionalized nanocrystals according to claim 12, wherein polynucleotide strands of the plurality of polynucleotide strands of the primary dots are hybridized to polynucleotide strands of the plurality of polynucleotide strands of the secondary dots.

16. The functionalized nanocrystals according to claim 13, wherein polynucleotide strands of the plurality of polynucleotide strands of the primary dots are hybridized to polynucleotide strands of the plurality of polynucleotide strands of the secondary dots.

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